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# Exploration and Practice of Case Teaching in Graduate Control Courses

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**Abstract:** With the growing team of graduate students, the uneven emergence of control theory foundation of the student source, the traditional classroom transmission mode and passive learning mode within the limited classroom teaching is difficult to achieve the expected teaching goals of the course. Therefore, reference and reference for further in-depth research on graduate education are expected by exploring diversified case teaching for the knowledge points of control courses and combining with the situation of the student source, cultivating the autonomy, creativity and systematic of the learning process of graduate students, and improving the teaching effect and education quality of graduate students.

**Keywords:** Case Teaching; Control Courses; Graduate Education.

## 1. Introduction

Graduate education is the most important way for a country to cultivate high-level talents, and the teaching of graduate courses has an important position in the cultivation of graduate students. In July 2020, the National Conference on Graduate Education was held, which opened the prelude to the construction of a strong country for China's graduate education. In September of the same year, the Academic Degrees Committee of the State Council and the Ministry of Education issued the Program for Professional Degree Graduate Education (2020-2025), which indicated the basic direction of professional degree graduate education in the next five years [1,2], at the same time, the Ministry of Education, the National Development and Reform Commission and the Ministry of Finance jointly issued the Opinions on Accelerating the Reform and Development of Postgraduate Education in the New Era, which clearly defined the main line of "cultivating moral character, serving the needs, improving quality and pursuing excellence", and put the guarantee and improvement of postgraduate teaching quality on the agenda [3]. While the scale of rapid development, how to promote the high-quality development of professional degree graduate education is an important research topic to which the academic community should pay attention [4].

According to the Opinions of the Ministry of Education on Strengthening Case Teaching and Joint Cultivation Base Construction of Professional Degree Graduate Students and the Opinions of the Ministry of Education on Improving and Strengthening Graduate Student Curriculum Construction, strengthening the construction of case teaching and case library is an important task in the reform of graduate education of professional degrees, and an important means to further improve the quality of training of graduate students with professional degrees. In recent years, colleges and universities have attached great importance to this work, and have taken the construction of case library as an important hand in the comprehensive reform of professional degree education, and have introduced special measures and promoted the reform of postgraduate teaching in the form of projects [5,6].

## 2. The Significance of Case Teaching

Case teaching is a teaching method that combines theory and practice, knowledge and skills [7], which is mainly to put students in a specific problem, let them take research problems as the center, guide students to study and research on the problem and background, through the analysis, discussion and exchange of the problem itself, and comprehensively use knowledge and experience to analyze and solve problems. Control course has a strong theoretical and practical, the task is to let students in fully understand and deeply grasp the establishment of the system model, the typical signal and link, system analysis and design, on the basis of exploring the application of control theory in the field of engineering, cultivate students with control theory analysis and problem solving ability, through the case teaching bridge communication between theoretical study and practice training, shorten the distance from theory to practice, to achieve the ideal teaching effect, and has certain reference significance to other courses for postgraduate students.

## 3. Main Problems Solved

### 3.1. The Problem of Uneven Quality of Students and Individualized Teaching

In recent years, some graduate students in universities have chosen to transfer their majors rather than their preferred majors, and their recognition of research fields and content may be lower than that of non transfer students [8]. According to the background of the student source and the application of its research field, new teaching content is introduced, and the course content is adjusted and reorganized in a timely manner, and typical cases are integrated into the course teaching, in order to solve the problem of the course content being out of sync with the background of the student source, the research field and the needs of the times, which is conducive to the sustainable development of the students.

### 3.2. The Problem of Students' Passive Learning Habits

Through the students' active preparation of the theoretical knowledge needed for case analysis before teaching, the

solution to the problem from different angles in the case situation is found to change the learning habits, solve the problem of passive learning to dominant learning change, mobilize the students' learning initiative, enhance the students' classroom participation, increase the amount of information ingested by the students, and, at the same time, effectively exercise and improve the students' ability to analyze, express, and teamwork.

### 3.3. Lack of Teaching Practice and Poor Applicability of Course Theory

Postgraduate lectures are basically theoretical teaching, building typical cases to introduce students into the case scenarios, taking the point to bring up the surface, draw inferences, cultivating students' good habits of independent learning and scientific research ideas, and equipping students with the ability to find out the problems, think independently, and solve the practical problems.

## 4. Practical Initiatives for Case Teaching

### 4.1. Constructing Diversified Case Teaching

In order to better apply diversified case teaching, starting from the teaching side objectives of the course, in the spirit of step by step, interlocking, gradual improvement, from point to surface, through the course system, reflecting the application of the course knowledge points of the principle of the four aspects of the typical case production, classroom sharing, simulation experiments, and in-kind production, as shown in Figure 1.

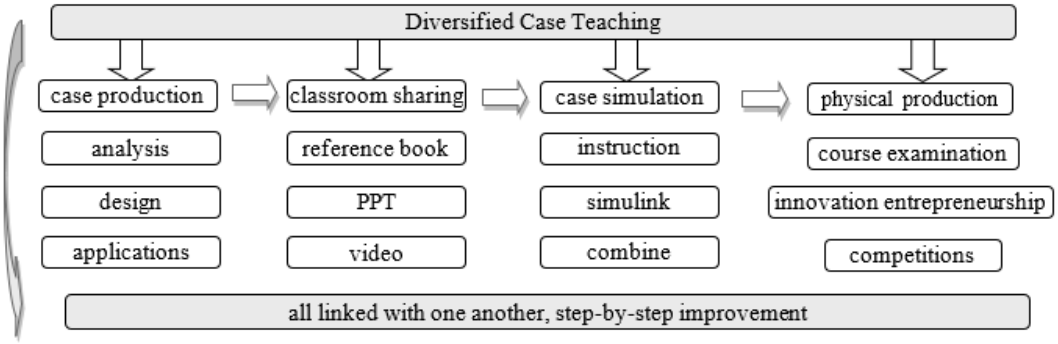



**Fig 1.** Diversified case teaching

### 4.2. Case Production

The typical case production is divided into three main parts: analysis, design and application. In the analysis chapter, the stability, accuracy and rapidity of the system are analyzed based on the model using time domain, frequency domain and other methods; in the design chapter, the controller is designed according to the specific performance index requirements, using the root trajectory, Bode diagram and other methods, to meet the requirements of the system performance; and the application chapter chooses its own research field and content to reflect the application of control theory.

### 4.3. Classroom Sharing

Since the derivation of the mathematical model, the performance analysis of the system and the design of the controller, the part of the case, which is equivalent to a comprehensive review of theoretical knowledge learning, and the emphasis and difficulty involved in the application process can be explained by textbooks, PPT and video.

### 4.4. Case Simulation

Simulation experiment writing Matlab instruction, Simulink model into teaching, from the traditional experiment box demonstration experiment, developed into validation, design, comprehensive experiment, ask students to prepare the case of Matlab language program or build Simulink model, then debugging, encounter difficulties as far as possible by the students according to the theory, let the students really as the main body of experimental teaching activities, give full play to its creative thinking and independent analysis, problem solving ability. The arrangement of the case content follows the principles of "combination of verification and design", "combination of design and synthesis", and "paying attention to the foundation and highlighting the application".

### 4.5. Physical Production

Physical production only rely on the knowledge of the course is still difficult, can be combined with other course knowledge together into the innovation and entrepreneurship projects and all kinds of competitions, so that the combination of theoretical knowledge and application, the real case of teaching education and teaching concepts, and at the same time, so that postgraduates know the main line and soul of the discipline, understand the logical connection between the professional courses, for their own vision of the future of the research and lay the foundation for the long term planning.

## 5. Feedback on Teaching Effectiveness

Relying on the teaching reform project of Tianjin Agricultural University for postgraduate education, "Construction of case library and case teaching practice of Control Theory and Application", the case teaching of the course has been well received by postgraduates in the process of exploring and practicing in the Electronic Information and Agricultural Engineering majors of the university and has begun to bear fruits, and the interest of postgraduates in this course has been really improved in the past two years. In the past two years, graduate students' interest in learning this course has been improved, and their analytical ability, teamwork ability and practical problem-solving ability have also been improved, and they have participated in more than 20 graduate mathematical modeling contests, college students' innovation and entrepreneurship contests, robotics contests, etc., and have achieved excellent results.

# 6. Summary

The reference significance to other courses for postgraduates can be achieved through exploring case teaching for different knowledge points of control courses and different needs of students, introducing new concepts, new ideas, new methods and new problems into case teaching, mobilizing students' enthusiasm and initiative in learning, broadening students' horizons and ideas, changing the habit of passive learning of postgraduates, cultivating postgraduates' ability to find out problems, analyze problems and solve problems, and at the same time cultivating innovation ability, teamwork ability , expression ability and hands-on ability, and bridging the communication between theoretical learning and practical training, shortening the distance from theory to practice, and achieving the ideal teaching effect.

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